Journal of the Society of Arts.

FRIDAY, SEPTEMBER 20, 1861.

INTERNATIONAL EXHIBITION OF 1862.

The Council beg to announce that the Guarantee Deed is now lying at the Society's House for signature, and they will be much obliged if those gentlemen who have given in their names as Guarantors, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate to £429,800, have been attached to the Deed.

MEDALS.

The medals to be awarded will be of one class, for Merit, by International Juries, whose names will be published in March 1862; and it is intended that the awards shall be published in the Exhibition Building, at a public ceremony, early in the month of June, 1862, and these awards will immediately afterwards be conspicuously attached to the counters of the successful exhibitors, and the grounds of each award will be very briefly stated.

CLAY MANUFACTURES.

At a meeting held at the Tontine Hotel, Ironbridge, Borough of Wenlock, on the 4th instant, present,—George Pritchard, Esq., High Sheriff of the County; John Pritchard, Esq., M.P.; C. J. Ferriday, Esq., Mayor of the Borough; John Anstice, Esq., J.P.; George Maw, Esq., F.S.A., and all the principal brick and tile manufacturers of the neighbourhood, it was resolved:—

"To organise, for the International Exhibition of 1862, a collective series, illustrative of the clay manufactures of the Coalbrookdale and Broseley coal-field, including the productions of Messrs. Maw, the Coalbrookdale Co., the Madeley-wood Co., Messrs. Burton, Mr. Exley, Messrs. Davis, Mr. Evans, Mr. Lewis, and other manufacturers of the district, in preference to each manufacturer exhibiting separately."

An influential Committee was formed for carrying out the project, and a subscription commenced, towards which nearly £100 was contributed at the meeting, for the purpose of defraying the expenses.

The following arrangements, in addition to those already published, have been made in foreign countries and the colonies:—

COSTA RICA.

H.M. Commissioners for the Exhibition of 1862 have received a communication stating that the following gentlemen have been appointed Commissioners to attend to the interests of Exhibitors from the Republic of Costa Rica:—Senores Don Luis O. von Schröter, Dr. Don Alesandro Frantzius, and Dr. Don Emilio Joos.

BRITISH ASSOCIATION, 1861.

The following papers were read before the Mechanical Section:—

ON THE APPLICATION OF WORKSHOP TOOLS TO THE CONSTRUCTION OF STEAM ENGINES AND OTHER MACHINERY. BY JOHN ROBINSON.

In treating the subject of "workshop tools," described otherwise as "machines for making machines," it has been thought well to limit the scope of the observations which will be laid before you to a recent period, during which the great increase in the employment of steam engines and machinery for the purposes as well of locomotion as for almost every branch of manufacture and agriculture, has stimulated the energies of mechanical minds to discover and apply the means, not only of keeping pace with the demands thus made upon them, but also of dealing with the increasingly ponderous masses of metal required in our steam marine and other engines of large size. They have at the same time been obliged carefully to keep in view the accuracy needed in the various details of the higher classes of machinery which we now see produced in our workshops.

LATHES.—The best known and most commonly applied constructive machine is the "lathe," this term embracing as well the amateur's "foot lathe," as the massive machine required for turning our large marine cranks and the centres of our paddle wheels and railway turntables.

Since the invention of the slide motion, these machines have rapidly improved in accuracy of construction, the time being easily recalled when in our machine factories the beds or benches employed for hand-turning lathes (that is, where the steam engine moved the machine, but the hand of the workman fashioned the object revolving in it), were simple beams of timber faced with sheet iron, and supported on cast-iron feet, or on wooden packing blocks. These are now almost universally superseded by cast-iron beds, planed by machine, and adjusted by the file; and in all well-furnished workshops compound slide rests are employed wherever the lathe is geared with sufficient power to permit their use, the self-acting principle being advantageously and simply applied to them by means of an eccentric fixed upon the revolving lathe spindle actuating a chain attached to a ratchet wheel upon the slide rest screw, which receives an impulse at each revolution of the lathe, and the tool is thus made to progress over the surface of the work in hand.

SPHERICAL REST.—A modification of the ordinary compound slide rest is frequently employed for turning spherical work, both externally and internally, the rest for this purpose having placed upon its upper slide a circular worm table, actuated by a corresponding worm made to revolve at the required speed by the hand of the workman.

Another step in advance of the self-acting slide rest is the "sliding lathe." In this the tool travels, unaided by the workman, not only along the cylindrical surfaces of objects, but also transversely to the work, thus permitting one workman to employ two or more lathes at the same time, and so inducing economy of labour. Another means of increasing the production of work from these machines is that of using several cutting tools in one lathe at the same moment. This is done in the "duplex" arrangement, by which one tool is made to cut upwards in the ordinary way at one side of the object, and a second tool placed opposite to it is taking another cut downwards, the cutting edge of the tool being reversed accordingly.

This operation, whether effected on a slide lathe, or on a compound rest lathe, will be readily understood to be a means of saving time, and thereby of decreasing the cost of the several parts of machines capable of being so operated upon.

It may be interesting to state that this multiplication of the number of cutting tools in one lathe has been carried to the extent of seven, all controlled by one workman, three of them being placed on the side of the bed next to him, and four on the opposite side, all worked by self-acting motions, and thus giving the operator time to watch the action of each. This lathe has been constructed chiefly for the purpose of turning cranked axles for locomotive and other engines, and when so employed, the three tools on the side next the workman are brought to bear longitudinally upon the cylindrical parts of the axle, while the four opposite tools—their cutting edges downwards—are made to act transversely upon each of the two crank sweeps,

the time for effecting the whole operation of turning the axle being thus materially shortened.

A very frequent application of the compound self-acting side rest is, to double face-plate lathes, employed for turning the rims and tyres of locomotive wheels. Many of these "wheel lathes" are constructed with four such slide rests, that is, two to each face plate, one of them holding the downward and the other the upward cutting tool, and placed of course at opposite sides of the objects being turned; the two faces of the rims or of the tyres of the wheels, and two of their sides, being thus operated upon at the same time.

Another form of lathe now in frequent use is the "gap," or "break bed lathe," which permits an object to be turned larger in diameter than that which the actual height of the centres above the ordinary surface of the bed would take in. These "gap lathes" are of two kinds, one being made with a fixed gap always existing, and without the means of closing it by pushing up the bed to the fixed headstock, and the other having the fixed headstock placed on a bolster, bolted to a long planed base plate on which the bed carrying the moveable headstock and slide rest can be shifted at pleasure, so as either to be in contact with the fixed headstock, or at such a distance from it as the object of large diameter may require.

The last class of lathe to which it is intended to refer, is the screw cutting lathe, which is a modification of the sliding lathe, and has the sliding tool carriage put in motion by means of an accurately cut guide screw and nut, the number of revolutions of which, required to give the various pitches of screws, is regulated by the application of "change" and "intermediate" toothed wheels, placed at the end of the fixed headstock, and capable of giving to the tool any required range of motion suited to the pitch of screw to be cut.

Other lathes for special purposes, such as gun boring, propeller turning, lathes with reciprocating motion to face plate, would require a larger space for their description than the limits of this paper would allow; but before leaving the subject of lathes, it may be well to call attention to the fact that the use of these now accurately constructed machines will fail of producing correspondingly accurate results, unless the workman be provided with the means of testing the exactness of his diameters, whether external or internal, the taper of his cones, the correctness of his curves, and the parallelism of his cylindrical objects, which cannot be done without the use of carefully constructed standard guages and templates, many of which are now preserved from a too rapid deterioration, by the hardening process which their surfaces, whether of steel or of iron, are made to undergo.

PLANING MACHINES.—The form of our earlier planing machines, like that of the older lathes, was very simple, although the invention took place at a much later period; but no long time elapsed before self-acting movements were applied to every required change in the direction of the cutting tool over the surfaces to be planed, whether these were horizontal, vertical, or at any angle whatever to the surface of the table. The use of the rack and pinion, and also of the screw and nut, for moving the table, soon succeeded to the original chain motion, the latter especially being employed in those machines where the cutting edge of the tool is reversed at each change of direction of the table, so as to cut during both the backward and forward movements, the speed of the table in both being the same, wherever this system of revolving tool is made use of; whilst in the case of most machines, with tool box arranged for cutting in one direction only, the table is made to return at a speed considerably quicker than during the operation of cutting.

As in the case of lathes so with these machines, the pressure of work to be produced in a given time led to the adoption of several tools cutting at the same moment, and this multiplication of cutting tools has been carried to the extent of employing eight at work simultaneously upon one machine, the power of moving the table being of course increased in the requisite proportion, and in most well-fitted workshops planing machines may be found having two, four, and six tools at work upon them.

Many years ago large planing machines were constructed with the view of operating upon fixed objects of great weight by means of travelling tools; since, in the cases sought to be thus dealt with, the weight of the tool slide and its fittings was considerably less than that of the object to be planed. This arrangement of machine, however, seems not to have obtained to any extent; most of the large masses involved in the ponderous machinery of the present day being planed on ordinary machines of great size, either by traversing them upon the table in the usual way, or by placing them near the side of the machine, and planing them by means of a cutting-tool fixed in a standard and slide-box travelling along with the table, and having a self-acting feed motion imparted to it at each return of the table. This mode of dealing with them is rendered almost imperative by the unwieldy size and form of some of the large castings now employed for constructive purposes.

An interesting adaptation to the ordinary planing machine has been made by the addition to it of a radial arm working upon a pivot, fixed vertically on a bracket extending some distance from the side of the machine, and made to reciprocate with a radiating movement by a pin inserted in the ordinary table, on which is fixed a block capable of adjusting itself in a groove of the radial arm prepared to receive it. By this arrangement objects fixed upon the extended surface of the radial arm receive a curvilinear motion when the table of the machine travels backward and forward, and when the tool fixed on the cross-slide is brought to bear upon the work, the cutting lines form arcs of circles corresponding with the length of their radii measured from the projected centre pivot, which latter being adjustable as to its distance from the vertical plane of the cutting tool, gives great facility for producing a considerable range of curves. This apparatus has been used chiefly for the expansion links or quadrants working the slide valves of locomotive engines, and for objects of analogous form.

It will be well, perhaps, here to refer to an arrangement of machine invented a considerable time ago in this country, and recently reproduced in the United States of America. This machine may be called a circular planing machine, and consists of a circular table made to revolve horizontally upon circular grooves by means of bevil gearing; above this table is fixed, upon vertical standards, an ordinary tool box, moved along the cross-slide by a self-acting screw motion, as in the common rectilineal planing machine. It will be obvious that a piece of metal bolted upon the table could have a true surface produced upon it by the tool applied from the cross-slide above, just as would be the case if it were fixed to the face-plate of a lathe, with a tool traversing in front of it. Machines of this construction seem to be almost obsolete in this country—the lathe and common planing machine being adequate to the production of all usual surfaces.

In consequence of the extensive introduction of hardened surfaces into our higher classes of engine work, it has been found necessary to employ grinding tables, to restore these surfaces to accuracy when irregularities exist after the "dipping" process in wrought-iron and steel, and the "chilling" in the case of cast-iron. Such tables are of two forms,—one like that of an ordinary planing machine, revolving stones or emery rollers being substituted for the steel cutting tools, and made to act upon the surfaces of the hardened objects by lowering the tool slide to them; the other form is a circular disc of copper or lead, in which grooves are cut for the reception of emery powder and oil, and on which, while revolving, the various objects are laid, and the faces brought up to the accuracy required. In both forms facilities have been obtained for the production in our engines of that hardness of rubbing surfaces which our high pressures, and the increasing weight of

the moving parts, are rendering every day more imperative.

DRILLING MACHINES.—In the process of putting together the objects which have undergone the operations of the lathe and planing machine, the drilling machine is called into requisition to produce the holes necessary for the bolts and screws used for fastening together the various parts.

Since the invention of the primitive drilling tool, this class of machine has undergone considerable improvement. For the larger holes, back-geared motions are now applied, resembling in principle those of the lathe headstock, the tools in these large machines being usually brought down to the work by means of worm or other such gearing, whether worked by the hand of the operator or by the machine itself.

A now increasingly frequent form of machine is the "Radial Drill," which consists of a drilling spindle mounted upon an arm, radiating, like the jib of a crane, from a central pivot, the length of the arc described by the drill being variable by a screw, or by a rack and pinion attached to the arm, and the elevation of the machine from the floor being effected by similar apparatus. Some of these machines are attached to independent cast-iron columns or frames, to which the pivoting brackets are fixed, while in others these brackets are simply bolted against the walls of the workshop. These radial machines are found particularly applicable when a great number of holes have to be drilled in large objects, since the drill can be brought to bear on any point embraced within the compass of the arc capable of being described by the cutting tool on the arm of the machine, and thus, not only does it become unnecessary to move the object every time a hole is completed, but the successive holes are produced exactly true with each other, and vertical to the face of the work operated upon.

For special uses drilling machines have been constructed on the planing machine type, having several drilling spindles revolving upon a cross-slide, in an analogous position to that of the cutting tools of a many-tooled planing machine. The objects to be drilled are fixed upon the table in the usual way adopted for planing, and where a number of holes are required to be drilled at regular intervals, it is readily accomplished by a self-acting movement applied to the table, coming into operation immediately one set of holes is completed, and bringing underneath the drills that portion of the object in which the next row of holes is required.

Another form of machine is that called the "slot drill," the intention of these machines being to produce slots or grooves in objects, by means of a drilling instead of a planing or slotting process. In the "slot drill" the article to be operated upon receives a self-acting reciprocation from a stud in a revolving disc, or other similar movement, variable in its extent according to the length of the groove or slot required to be cut, the drilling tool being brought down to the work, at the same time, by one of the ordinary self-feeding processes; by these means a groove of any moderate depth is produced in pins or small shafts, or in any other objects requiring slots or grooves of no great size.

Following upon this machine came the "traversing drill," having a similar end in view, but adapted for larger objects and suited for more accurate work. In this machine the drilling headstock itself is made to reciprocate, by means of a revolving disc movement, along an accurately planed bed, the object to be grooved or slotted being fixed upon a table firmly bolted to the bed, and adjustable by a hand-screw motion; the required length of traverse of the headstock is imparted by a connecting rod actuated by a stud in an indexed groove of the revolving disc, the position of which is regulated by the workman according to the length of slot to be cut, the index marks guiding him readily to the required position. The revolving disc is set in motion by an elliptical spur-wheel cast upon it, and worked by a pinion, keyed eccentrically upon its shaft, so as to accommodate itself to the varying diameters of the pitch line of the elliptical wheel. The object of this arrangement is to obtain a more regular speed in the lateral motion of the tool than would result from an ordinary circular wheel and pinion, which obviously would give a very rapid movement in the middle of the length of the slot, and a very slow one at the two ends. The vertical feed motion is also self-acting and takes place during the slowest portion of the traverse of the headstock, and by this means great regularity and accuracy of effect are obtained, since the drilling tool is not required to cut vertically and laterally at the same time. In many cases, two headstocks and two tables are fitted upon one bed, by which arrangement two ends of a connecting rod, or other similar piece of work can be operated upon simultaneously, and as these drilling headstocks are provided also with self-acting vertical feed movements, which can be used independently of the traverse motion, they can be conveniently employed for ordinary round holes; and when two heads are fixed at any required distance apart upon the bed, it is evident that any number of similar objects can be drilled consecutively by them, and the distance from centre to centre of these holes will always exactly correspond. This machine has been constructed also upon the cross-slide or planing machine type, in which arrangement the objects to be slotted can be placed between the vertical standards or "uprights," and the slot-holes or grooves can be produced either in a line parallel with, or transversely to, the axis of the object in hand, such as an engine beam, a cross head, a piston-rod, or pump-ram of a stationary or marine engine. The use of this class of drilling machine obviates the difficult and expensive process of making cotter and slot-holes, by first drilling through the object a row of cylindrical holes, and afterwards slotting them or chipping and filing them by hand labour; besides which more accurate and highly finished work is obtained from it without any hand adjustment whatever than is ordinarily practicable where manual labour is employed for the purpose.

SLOTTING MACHINES.—Next in order to the drilling machine follows the "slotting" or "key grooving machine;" this machine was brought into use many years ago, and has been gradually enlarged in size and capacity to keep pace with the increased dimensions and weight of the masses now required to be operated upon. Its first form was one which the name "key grooving engine" describes, viz., a machine for cutting the grooves in wheel bosses or naves to receive the keys by which they are fixed upon their shafts or axles; subsequently other uses were discovered for this machine, the main feature of which is a tool reciprocating vertically, and convenient motions were added to the table arranged under the tool, the result being an admirable machine having self-acting circular, longitudinal, and transverse motions applied to the tables, by which means the scope of the machine is extended to the production of all forms of outline to which a tool cutting in a vertical direction can be applied; the paring or chiselling operation being now perhaps more frequently employed in this machine than the first one of "key grooving."

A very useful modification of this machine has been constructed in general arrangement like the bed and table of a planing machine, having two pairs of "uprights," or standards with cross beams attached to them; on these are worked "slotting" tools of a moderate length of stroke and capable of receiving a transverse, as well as a longitudinal motion, so that the two tools can be brought to bear upon the vertical surfaces of any large object fixed upon the table, and thus at the same time can be pared or slotted two surfaces whether curved or rectilinear outline. The chief object of this arrangement seems to have been the shaping of the edges of locomotive frames, several of which may be placed one above another on the table, and their edges brought simultaneously to the required form. The two tools of the machine working at the same time

expedite the completion of the work in hand, and thus an economy of time and labour results.

SHAPING MACHINE.—Following upon the "slotting machine," with its vertically working tool, comes the more recently invented "shaping machine," called by our French neighbours the "Limeuse," or "filing machine."

The cutting tool of the "shaping machine" reciprocates horizontally, and in its simplest form is often called the "steam arm." In this the stroke is usually short, say six inches, and no quick return motion is given to it. The surfaces cut by it are flat only, and are traversed along under the tool by a ratchet movement working a screw, having its nut fixed in the table on which the work is placed. The more advanced form of this machine is that in which the work is stationary, bolted on tables fixed to the bed or frame of the machine, and the tool moved along in a travelling head, actuated by a ratchet motion and screw, in a somewhat similar way to that of the table of the "steam arm." This mode of operation gives facilities for cutting larger objects with more extended surfaces, and at the same time permits of curvilinear and cylindrical outlines being produced, the former by a sector and worm motion on the tool box itself, giving the tool a radial action, and the latter by fixing the cylindrically shaped object on a mandril, made to rotate by a self-acting worm and wheel motion attached to the bed of the machine; the tool in this case merely reciprocates in the same line, without having lateral motion applied to it, the rotation of the work itself bringing the successive parts of its surface under the cutting edge.

Various arrangements have been applied to this machine to render the speed of the tool greater on returning from than when making the cut, one consisting of a spur wheel, driving, by means of a stud in its surface, a shaft revolving eccentrically with it. By this apparatus the cutting process is made to occupy about three-fifths of the period of the revolution of the spur wheel to which the movement is attached, the time of the return stroke occupying the remaining two-fifths of the revolution. The distance from the centre of motion is greater during the cutting than in the return stroke, and the power brought to bear upon the tool is proportionately greater during that operation.

Another and very simple method of attaining the same result is the application of a slotted link, radiating from a fixed point, and giving motion to the cutting arm at the other extremity by the intervention of a pin fixed in a revolving disc, and passing through a block sliding in the slotted link. Motion is imparted to this disc by ordinary spur gearing, and the greater the distance from the centre at which the pin is placed, the longer the stroke of the cutting tool, and the greater, at the same time, is the difference between the cutting and returning speed imparted to it.

The length of stroke of tool applied to these machines is continually increasing, and many "shaping machines" are now constructed with two or more cutting heads upon one bed, so as to give greater facilities in fixing the work, and to enable the workman to attend to more than one cutting tool at the same time.

The last form of shaping machine to which it is intended to direct attention, is that used for the purpose of shaping the sides of nuts and the heads of screws or bolts. These machines have been usually made with revolving cutters, the form now employed having two such cutters rotating upon a shaft, their disc faces toothed, and placed at such a distance asunder as to allow the exact finished dimension of the nut or screw head to pass between them; a series of nuts, varying in number according to their size, may be placed on a mandril, fixed by jaws, and a centre point, to the necessary dividing plate, and by a sliding movement of the table they can be passed between these cutters, so as to finish at once to the required dimensions the two opposite sides of the range, all the spring and jar incident to a one-sided cut being avoided by the resistance offered by the operation of the second cutting face. Such machines are readily applied to a variety of other purposes, such as grooving screwing taps, cutting out forked joints, and a large class of similar work, the form, diameter, and speed of the circular revolving cutters being varied to produce the results desired.

WHEEL CUTTING MACHINE.—A machine of a somewhat analogous character is the "wheel cutting machine," constructed for the purpose of cutting the teeth of wooden or iron wheel patterns or models, whether these are of the ordinary "spur" form or for bevil, mitre, or worm wheels. In the older machines the wooden or iron pattern required to be cut is placed upon a horizontal spindle, under, or at one side of which the headstock, with its revolving tool, is fixed upon a slide of sufficient length to travel across the toothed face of the pattern wheel. Some of the more recent machines have been made to cut pattern and other wheels while fixed in a vertical position; and as in much of the spinning machinery now in use wrought-iron toothed wheels are employed, it was needful to construct more simple apparatus for cutting them; amount of production being, in this case, a greater desideratum than great exactness of form and finish. The production of the revolving cutting tools, employed in these machines at a cheaper rate than was possible by hand turning and shaping, has been accomplished by the application of the "pentagraph cutting machine," in which, after undergoing the turning process, the serration, or toothing of the steel cutter discs is effected by small revolving cutters, actuated on the "pentagraph" principle of proportionate adjustable arms starting from the shapes required, and keeping the cutter up to its work with the most minute accuracy; without some such mode of preparing them it is obvious that these cutters would be most costly, and even now, with all modern appliances for their production, the value of each, in proportion to its size, is still considerable.

BOLT AND NUT SCREWING MACHINES.—A machine which has made rapid progress of late years is that used for cutting out the threads of bolts, screws, and nuts. Many forms and arrangements of machine are now in use for this purpose, most of them consisting of a revolving head, somewhat like a lathe head-stock, fitted with a cone-speed pulley, to vary the number of revolutions according to the diameter of the bolt and nut to be cut. The cutting dies are fixed in a box driven by this head, and the bolt is inserted into a sliding frame travelling upon the bed of the machine in front of the die box. In most cases the process of passing through the dies is repeated twice, and even three times for large bolts, before the requisite fullness and quality of thread are obtained. When nuts are to be cut they are usually fixed in the sliding frame, and the tap inserted in the die box of the revolving head is run through them, and the requisite thread at once produced.

Recently a very ingenious bolt and nut cutting machine has been introduced from the United States of America, in which the cutting dies consist of three separate tools arranged concentrically in the die-box, and kept to their work by curved inclines fixed upon the die holding box; the plate forming the front cover of this box has attached to it three curved inclines, corresponding with those of the die box; the die pieces are notched so as to fit upon these latter inclines, and by these notches they are drawn back when each bolt is screwed, and by these means it is at once released.

The internal portion of the box holding the dies is capable of being worked backward and forward by the gearing of the machine itself. This backward and forward movement is produced by the application of two spur wheels of different diameters, keyed upon hollow shafts, one driving the die box when cutting, and the other forcing round the curved inclines in such a way as to effect the withdrawal of the dies. This latter is thrown into gear by a friction clutch box moved by a lever, put into operation by the workman when the requisite length of thread is cut, and when the lever is again released the smaller wheel is thrown out of gear, and the dies resume their

cutting position. The machine then works thus:—The bolt to be cut is fixed into the sliding frame concentrically and accurately by means of "gripping" dies, simultaneously brought together by right and left-handed screws; it is then pressed into the die box by the action of a ratchet lever, and the dies, formed like chasing tools, but with some taper on their cutting faces, completely turn out the thread from the surface, and produce, at one passage of the bolt, a perfectly finished thread, after which, by means of the lever and inclined wedges, the die pieces are at once opened, and the bolt withdrawn instantaneously, without stopping the machine or even reversing its motion; thus great economy of time is gained, and the work produced is of superior quality to that in which the thread is compressed and drawn out by ordinary dies. Nuts are screwed in this machine in the manner already described for the usual construction of machine.

It will be sufficient, for the object of this paper, to mention very briefly the facilities which now exist for the economical production of work in the forging and boiler-making processes, as compared with the condition of things twenty or thirty years ago. The great agent in economising labour in the forge and smith's shop is the steam hammer in its various applications. Originally adopted by engineers, more perhaps for the purpose of working up economically and conveniently the scrap wrought-iron produced in their own establishments, the steam hammer has now become the necessary adjunct of every well-mounted smith's shop, not only working up into useful forgings the scrap iron there to be obtained, but producing pieces of large size, or stamping under conveniently arranged dies all possible shapes of iron work, the "fins" or overplus left on the edges of which are rapidly sheared away by powerful shearing machines, and thus the productions of the steam hammer are, in many instances, passed forward into the planing and turning shops without the intervention of the smith and his assistant hammer men.

Steam-power has likewise been usefully employed in smaller classes of machines for forging bolts, rivets, and other articles of that nature, where large numbers of objects of similar form are required.

Punching and shearing machines also, of enormous power, are now in constant use for punching plates 1¼-inch thick, and for shearing bars, plates, &c., up to 4, and even 6 inches, so that all the cutting-off processes are effected either by their means or by the employment of circular saws running at high velocities, and brought to act upon the iron while hot from the hammer, from the rolls, or from the smith's fire.

The operations of the boiler-maker are likewise much facilitated by the employment of steam for the riveting process; several adaptations of steam riveting machines have been applied, all of which have some peculiar points of excellence. The work produced is generally of first-rate quality, tighter in most instances than where hand hammers are employed, and obviously the operations of riveting are much more rapid, especially where suitable steam cranes are used for the convenient manipulation of the large objects to be operated upon.

A riveting machine originally constructed to work by steam has been recently modified to suit the application of hydraulic power, and with results in every way satisfactory.

From this somewhat rapid survey of the chief classes of workshop tools applied to the construction of steam-engines and other machinery, it will be seen that the means now placed within the reach of the mechanical engineer are vastly superior, both in variety and excellence, to those which were at his disposal thirty years ago, when locomotion by steam, both on the land and on the water, first began to make serious demands upon his constructive powers. These demands, accompanied as they were by the application of machinery to all those branches of manufacturing industry which were ready to spring into vigorous existence immediately the necessary transport of material was provided for, stimulated the energies of constructive minds, and the results may be seen on every side when visiting the large establishments of our city.

As an index of the enormous increase in the application of constructive machines in this country since the year 1830, the following figures and facts are placed before you:—

First.—The exportation of steam-engines and other machinery has progressed thus:—

In the five years—	£
From 1831 to 1835 total exports of machinery	845,203
,, 1836 to 1840 ,, ,,	2,699,339
,, 1841 to 1845 ,, ,,	3,500,565
,, 1846 to 1850 ,, ,,	4,940,939
,, 1851 to 1855 ,, ,,	8,579,533
,, 1856 to 1860 ,, ,,	17,756,136

Second.—During these thirty years the whole of our railway system at home has grown up, with its thousands of locomotives and other accompanying machines.

Third.—In the same period nearly all our existing steam vessels, as well for commercial as for governmental purposes, have been brought into being.

And Fourth.—Our exportation of manufactured cotton, woollen, linen, silk, and other goods, implying a corresponding increase of machinery for their production, has risen from the sum of £38,000,000 in 1831, to the almost incredible amount of £132,000,000 in 1860.

Without the aid, then, of labour-saving tools, no one can suppose that the immense increase in the manufacture of machinery indicated by the foregoing facts could have taken place. Without these tools we must have proceeded at a very much slower speed in every department, and when it is considered that the increase in the number of these machines involves the corresponding increase in the number of workmen employed in their construction, the country may congratulate itself on the existence amongst us of a large class, not only of well-paid, but of very intelligent work-people, the demand for whose labour, as in the case of all manufacturing industry, is rapidly increased, in proportion to the application of machinery to cheapen its productions.

On Street Railways. By J. Haworth.

The object of the following paper is to explain certain improvements in street railways, for which I have obtained letters patent, and which, from the circumstance of their differing from the ordinary modes of laying and working railways, I am disposed to believe not unworthy the attention of the Mechanical Section of the British Association.

I may be permitted, at the outset, to state that my attention was first directed to street railways by the circumstance of the Corporation of the City proposing to grant permission to lay down upon one of our leading thoroughfares a system of rails which I believed to be objectionable, both from the impossibility of the proposed carriages using the road, and from the rails projecting above the surface of the roadway, and thereby not only inconveniencing all light traffic, but rendering the roadway dangerous to horses. On examining the line laid down at Birkenhead, which was the same as that proposed for Manchester, and comparing it with the street railway in Paris, which has the centre of one rail grooved to correspond with a projection on the tyre, I came to the conclusion that the latter was certainly less objectionable than the former, from its being level with the surface; but it appeared to me that the grooving of one line of rails in the French system limited its use, and entailed both inconvenience and delay in changing one set of wheels for another when it was necessary for the vehicle to leave the rails and take the road. It then occurred to me that the objections both to the American and the Paris schemes might be overcome by the introduction of a middle rail, which, being grooved for the reception of a revolving disc at-

tached to the vehicle, would form a guiding rail of itself, and wholly dispense with the necessity of flanged wheels and raised rails.

In the system which I have patented, the outer rails are of 3-inch T-iron, grooved into longitudinal dovetailed sleepers of Dantzic timber, which are 3½ inches at the top, 4½ inches at the bottom, and 6 inches deep. The groove of the sleeper receives a tongue of the rail, which is driven tight in, and screwed down with common screws, firmly uniting the two, and imparting mutual strength and support, as tyres do to wheels, and wheels to tyres. The centre rail is a small-sized Brunel rail, reversed, only 2½ inches wide. The groove on its surface is $\frac{9}{16}$ths of an inch in width at the top, $\frac{3}{8}$ths at the bottom, and one inch deep. The rails being laid perfectly level with the roadway, present no obstruction to the ordinary traffic. The perambulating wheel, which works in the grooved rail, is 11 inches in diameter, and is centred in a bar hinged to the fore-axle of an ordinary omnibus, and duly spurred, so that, as the wheel revolves, the axle is always at right angles to the rails. The apparatus is supported above the road by a chain attached to a lever fixed to the footboard, which the driver, at pleasure, can raise or lower, and then, with the greatest ease, either take or leave the rails. The facility of running off the rails renders it unnecessary, except in the case of very extensive traffic, to have a double line, as, by arrangement, the descending omnibus can give place to the ascending, and the use of sidings are dispensed with.

The main advantages which this arrangement presents are:—

1st. Cheapness of construction. Neither cross sleepers, chairs, nor tye-rods are required, nor, in fact, any other of the present railway appliances.

The metals can be supplied, drilled and countersunk, at £8 per ton. The three rails combined weigh 64lb per yard, and one ton will lay 35 yards, or 50¼ tons one mile. The sleepers, creosoted by Bethel's patent, cost 6d. per lineal foot, and can be put down by joiners and labourers at a small expense. The total cost, therefore, per mile of rails complete, will not exceed £1,000. Perambulators, suited for any four-wheeled vehicle, can be supplied for the sum of £5 each.

2ndly. This system presents no impediment whatever to ordinary traffic, the rails being level with the road, and therefore crossed without offering any obstruction.

3rdly. No special vehicles are required to be constructed for this system, for the central wheel with its apparatus can be attached to all existing omnibuses and conveyances at a trifling expense.

4thly. It is calculated that a saving of 35 per cent. will be effected in haulage power, and of 75 per cent. in wear and tear of rolling stock, by this system.

5thly. The increased ease and comfort in travelling need scarcely be pointed out; the practicability of conversing with your neighbour in an omnibus is not the least of the advantages of a noiseless system, and a smooth road occasions less fatigue to the passengers.

The application of such a system of street railways upon the centre to the suburbs of large towns, cannot fail to afford great convenience to the public, and to be a lucrative undertaking to proprietors. The existing railway scarcely met the requirements of communities rapidly extending themselves over the outlying districts of our principal cities, and the advantages of being securely and comfortably put down at one's own door, or in one's own street, need scarcely be pointed out. Upon such a street railway two horses would be able to convey 40 passengers in an omnibus weighing 30 cwt., and costing £150, whilst the ordinary first-class railway carriages required to carry 40 passengers weigh 9 tons, and cost about £700. In fact, for such short distances as those referred to, street railways may be considered in point of economy a step in advance, as marked as the introduction of railways was in speed over the old system of coaching.

If the trustees of turnpike roads in populous districts were, at their own expense, to put down rails for omnibus use, the expenditure would soon be recovered by the economy which would result from the traffic being transferred from the road to the rails, and coach proprietors, in addition to the ordinary tolls, would doubtless consent to pay mileage, in return for the saving effected in horses and rolling stock, and with the reasonable expectation of a continuous increase in the number of passengers.

In conclusion, I have to express my conviction, derived from lengthened practical knowledge of road maintenance, that some system of street railways, whether that which I have attempted to explain, or any other system, must ere long become an institution amongst us to keep pace with the growing traffic of our large cities, and to meet the requirements of an increasing commerce.

The model before you is constructed upon a scale of ½-inch to the foot, and is designed to put the perambulating theory to the severest practical test. The curves are quick and the junction of the rails is at an acute angle; yet it will be found that the wheels of the vehicle retain their position upon the rails, and that the centre wheel traverses the groove with regularity and certainty. I have prepared models of omnibus, cab, and lurry, in order to show the applicability of my system to various classes of vehicles.

EXAMINATION PAPERS, 1861.

(*Continued from page 647.*)

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in April and May last:—

GEOGRAPHY.

THREE HOURS ALLOWED.

The candidate is not allowed to answer more than *twelve* of the following questions. It is imperatively required that *either No.* 1 *or* 2 (or both, if preferred by the candidate) shall be amongst the twelve selected for answers.

1. Draw a rough Map of any one of the counties of Great Britain or Ireland—showing its general shape, the relative places of its high and low grounds, and the courses of its principal rivers. (If the county selected include a coal-field, or other important mineral deposit, mark the locality.)

2. Draw a rough Map—showing the high and low grounds, rivers, lakes, and sites of principal towns—of any one of the following countries:

(*a*) Italy.
(*b*) Switzerland.
(*c*) Russia in Europe.

3. Name the principal rivers in Great Britain and Ireland, in order of geographical succession, with the seas into which they fall.

4. Specify the positions of the following places:—Bourdeaux, Trieste, Stettin, Odessa, Helsingfors, Bahia, Valparaiso, Charleston, Batavia, Rangoon, Muscat, and Kurrachee.

5. Write a short account of the Ionian Islands—giving the names of the principal islands, with some particulars respecting their climate, commercial produce, and inhabitants.

6. Enumerate the states hitherto comprehended under the title of the United States, classifying them as they lie—(1.) On the Atlantic sea-board; (2.) Within the Mississippi valley; or, (3.) To the west of the Rocky Mountains. Distinguish by a mark (*) those of them that are slave states.

7. From what other countries, besides the United States, has the supply of raw cotton to Britain been hitherto derived? Name, in addition, any regions elsewhere, of which the climate, soil, and other conditions,

are such as to warrant the expectation of a future supply of that material.

8. Name the Australian colonies of Britain, specifying, in the case of each, the chief characteristics of climate and produce, and the names of its principal towns.

9. Among localities of historic note in Britain, are Bannockburn, Culloden, Towton, St. Alban's, Runnymead, Naseby, Flodden, Dunbar, Colchester, Bosworth, Killiecrankie, and Kenilworth: name the county in which each is situated.

10. Make a list of the principal mountain-chains in each division of the globe (Europe, Asia, &c.), stating, in the case of each, whether its general direction is north and south, or east and west.

11. What are the Monsoons? Where do they prevail, and how is their prime characteristic to be accounted for?

12. Write a brief description of *any one* of the following rivers—stating its course, general character of basin, chief tributaries, capability of navigation, and any other particular of importance:—

(*a*) St. Lawrence.
(*b*) Yang-tsze-kiang.
(*c*) Nile.

13. State briefly the chief causes to which differences of climate are due. Give some instances of particular countries or districts in illustration.

14. The indigenous productions (vegetable and animal) of the New World differ strikingly from those of the eastern half of the globe. Give some examples of this—in the case, more especially, of the food-plants, and of the domesticated quadrupeds.

15. What towns in the British Islands are distinguished as seats of the following manufactures:—cotton, linen, woollen and worsted, silk, cutlery, hardware in general, and earthenware?

16. Name, in geographical succession, the countries that lie round the Mediterranean Sea; and also the principal commercial ports that are upon its shores, with the particular locality of each.

ENGLISH HISTORY.

THREE HOURS ALLOWED.

1. Give a short life of Alfred, and mention the principal institutions that have been rightly or wrongly ascribed to him.

2. Explain the feudal system.

3. Give a short history of the dispute between Henry II. and Thomas à Becket.

4. Trace the growth of Parliament and its privileges down to the reign of James I.

5. Give, with dates, a short outline of the history of Queen Elizabeth.

6. Give a short history of the causes that led to the war between Charles I. and his Parliament.

7. What parliaments sat between 1638 and the Restoration, and what were their principal measures?

8. Give, with dates, a short life of Oliver Cromwell.

9. Give a short abstract of the Bill of Rights.

10. Explain the South Sea scheme.

11. Who were Prime Ministers under George III? Give the names in chronological order, and mention any remarkable events that occurred during their periods of office.

12. Between whom, and in what reigns, were the battles of Hastings, Lewes, Towton, Pinkie, Naseby, Blenheim, and Vittoria fought? Describe one of them.

13. What was the relationship of Queen Elizabeth to James VI. of Scotland, and what claim had James to the throne of England during Elizabeth's life-time?

14. Enumerate the principal British possessions.

ENGLISH LITERATURE.

THREE HOURS ALLOWED FOR THE TWO AUTHORS SELECTED BY THE CANDIDATE.

SHAKSPEARE.

Othello; Richard III.; As You Like It.

1. To what person does each of the following passages belong, and in what connection is it introduced? Explain the allusions, and anything which may be remarkable in the words or grammatical construction:—

(a) And this our life, exempt from public haunt,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything.

(b) Hold your hands!
Both you of my inclining and the rest:
Were it my cue to fight, I should have known it
Without a prompter.

(c) Conscience is but a word that cowards use,
Devised at first to keep the strong in awe.

(d) And then he drew a dial from his poke,
And looking on it with lack-lustre eye
Says very wisely, "It is ten o'clock:
Thus may we see," quoth he, "how the world wags."

(e) But, God be thanked, there is no need of me;
And much I need to help you, were there need:
The royal tree hath left us royal fruit,
Which, mellowed by the stealing hours of time,
Will well become the seat of majesty,
And make, no doubt, us happy by his reign.

(f) Not poppy, nor mandragora,
Nor all the drowsy syrups of the world,
Shall ever medicine thee to that sweet sleep,
Which thou owedst yesterday.

2. Give the sense of the following passages in simple prose. From whence are they taken?

(a) Now are our brows bound with victorious wreaths,
Our bruised arms hung up for monuments,
Our stern alarums changed to merry meetings,
Our dreadful marches to delightful measures.
Grim visaged war hath smoothed his wrinkled front
And now, instead of mounting barbed steeds
To fight the souls of fearful adversaries,
He capers nimbly in a lady's chamber,
To the lascivious pleasing of a lute.

(b) Good name in man or woman, dear my lord,
Is the immediate jewel of their souls.
Who steals my purse, steals trash; 'tis something, nothing—
'Twas mine, 'tis his, and has been slave to thousands;
But he that filches from me my good name,
Robs me of that which not enriches him,
And makes me poor indeed.

SECTION II.

1. To what political prejudice has Shakspeare been charged with yielding in Richard III.? On what particulars in the play is the charge founded?

2. Compare the character of Richard III., as drawn by Shakspeare, with that of Iago.

3. From what sources does the foundation of the plots of Othello, and As you Like it, appear to have been derived?

4. Give a brief sketch of the plot of the first two acts of Othello?

5. What are the probable dates of the composition of the three plays? What do you know of the existing authorities for the text of each?

BACON.

(Essays.)

I.

1. How does Bacon define the following terms:—"Cunning," "goodness," "goodness of nature," "simulation?"

2. Explain the following passage:—

(a) Superstition hath been the confusion of many states, and bringeth in a new *primum mobile* that ravisheth all the spheres of government.

(b) Plato had an imagination that all knowledge was but remembrance; so Solomon giveth his sentence, that all novelty is but oblivion. Whereby you may see that the river of Lethe runneth as well above ground as below.

3. Explain Bacon's use of the following words:—"Shrewd," "mere," "politics," "arietation," "quecking," "favour," "adust," "push," "lurch," "newel," "obnoxious," "commodity," "foil."

4. Explain the following passages:—

(a) Dangers are no more light if they once seem light; and more dangers have deceived men than forced them.

(b) Virtue was never so beholden to human nature, as it received its due at the second hand.

(c) Superstition is now so well advanced that men of the first blood are as firm as butchers by occupation; and votary resolution is made equipollent to custom even in matter of blood.

II.

1. Give a brief analysis of the essay of Atheism.

2. Give some account of the following persons mentioned in Bacon's Essays:—Busbechius, Apollonius of Tyana, Celsus, Tamerlane.

3. Macaulay says:—"It rarely happens that the fancy and the judgment grow together. It happens still more rarely that the judgment grows faster than the fancy. This seems, however, to have been the case with Bacon." Illustrate this position from the Essays.

4. Compare the style of Bacon's Essays with that of any other essayist with whom you may be acquainted.

5. How is the morality of Bacon's Essays illustrated by his life?

MILTON.

(Paradise Lost. Books I. to IV.)

1. Explain the connexion of each of the following passages, and notice any remarkable uses of words or peculiar grammatical constructions which may occur in them.

(a) What though the field be lost?
All is not lost; the unconquerable will
And study of revenge, immortal hate,
And courage never to submit or yield,
And what is else not to be overcome;
That glory never shall his wrath or might
Extort from me.

(b) For what can force or guile
With him, or who deceive his mind, whose eye
Views all things at one view?

(c) Which when Beelzebub perceived than whom,
Satan except, none higher sat, with grave
Aspect he rose, and in his rising seemed
A pillar of state.

(d) The louring element
Scowls o'er the darkened landskip snow, or shower.

(e) Him round
A globe of fiery seraphim inclosed,
With bright emblazonry and horrent arms.

2. Explain the allusions in these passages, and state their context:—

(a) As when by night the glass
Of Galileo, less assured, observes
Imagined lands and regions in the moon:
Or pilot, from amidst the Cyclades
Delos or Lamos first appearing, kens
A cloudy spot.

(b) As at the Olympian games, or Pythian fields;
Part curb their fiery steeds, or shun the goal
With rapid wheels, or fronted brigads form.

(c) And like a comet burned,
That fires the length of Ophinchus huge
In the arctic sky, and from his horrid hair
Shakes pestilence and war.

(d) Confounded Chaos roared
And felt tenfold confusion in their fall
Through his wild anarchy.

(e) Anon they move
In perfect phalanx to the Dorian mood
Of flutes and soft recorders.

3. Express the sense of the following in plain prose:—

His form had not yet lost
All her original brightness, nor appeared
Less than Archangel ruined, and the excess
Of glory obscured: as when the sun new-risen
Looks through the horizontal misty air,
Shorn of his beams; or from behind the moon,
In dim eclipse, disastrous twilight sheds
On half the nations, and with fear of change
Perplexes monarchs: darkened so, yet shone
Above them all the Archangel,

4. Explain these words and phrases:—

adamant	Sabæan odours
empyrean	sovran
arreed	fourfold-visaged Four
amerced	hosting
anarch	this less volubil earth

SECTION II.

1. Briefly state the argument of the Fifth Book of Paradise Lost.

2. Give some account of the circumstances under which Paradise Lost was written.

3. What objections have been made to Paradise Lost, on the ground that its subject is not fit for an epic poem? What is your own opinion on the subject?

4. What are the principal allusions to the poet himself in the poem.

5. Which are the most important prose works of Milton?

CRAIK.

(Outlines of the History of the English Language.)

1. Who were the Angles, Saxons, Jutes, and Frisians?

2. Give a list of Latin words admitted into the English language before the Conquest.

3. Show by a table the various branches of the Indo-European family of languages.

4. When did the following writers live:—Robert of Gloucester, Robert of Brunne, Holcott, Higden, Layamon, and the author of the Ormulum? Give some account of their writings.

5. What is meant by "Middle English," "Latin of the Third Period," "Early English."

6. What two tendencies mark the language of Chaucer and his contemporaries?

7. What traces are there of a Scandinavian element in the English language, and in our topographical nomenclature?

8. Sketch the history of the English language between A.D. 1000 and A.D. 1400.

9. What peculiarities distinguish the language of the Ormulum from the Original English.

10. Write the following passage in modern English:—

Here fon heo durre the lasse doute, but hit be thorw gyle
Of fol of the selve lond, as me hath y seye wyle.

Explain as far as you can its grammatical construction.

TRENCH.

(English, Past and Present.)

1. Give some accounts of the different elements out of which the English language has been formed, and state the proportion in which each of them is said to exist.

2. State what is meant by "a living language."

3. Give some examples of the gradual way in which foreign words generally obtain a footing in our language.

4. The language of Chaucer is said to have been less intelligible to Dryden and his contemporaries than it is to us. Explain this statement.

5. Give some instances of good words being dropped in our language, and worse ones taking their place.

6. What is the difference between strong and weak præterites? Exemplify the tendency in modern times to drop the former.

7. Show how some words have contracted, and how others have expanded their meaning.

8. State the word which is derived from the same source as each of the following, and explain the difference of meaning:—tradition—hospital—secure—persecute—faction—fealty—ransom—parcel.

(9.) Explain and give the origin of each of these words:—

chimerical	tantalise	pasquinade
hermetic	academy	sycophant
spinster	lazaretto	Tartar
dunce	simony	gossip

(10.) What changes of meaning have the following words undergone:—religion—his—knave—villain—worship—miscreant?

CHAUCER.

SECTION I.

The busy larke, messager of daye,
Salueth in hire song the morwe gray;
And fyry Phebus riseth up so bright,
That all the orient laugheth of the light,
And with his stremes dryeth in the greves
The silver dropes, honging on the leeves.

The destine, mynistre general,
That executeth in the world over al
The purveans, that God hath seye byforn,
So strong it is, that they the world had sworn
The contrary of a thing by ye or nay,
Yet some tyme it schal falle upon a day
That falleth nought eft in a thousend yeere.
For certeynly oure appetites heere,
Be it of ware, of pees, other hate, or love,
Al is it reuled by the sight above.

Wost thou nat wel the olde clerkes sawe
That who schal geve a lover eny lawe,
Love is a grettere lawe, by my pan,
Then may be geve to eny erthly man?
Therefore posityf lawe, and such decre,
Is broke alway for love in ech degree.

(a) Turn each of the above passages into modern English.

(b) Explain the obsolete words and constructions.

(c) Which words does the versification require to be pronounced in a manner contrary to modern usage?

2. Give the meaning of the following words and phrases:—

asegid	waymentynge	seistow
to ere	crydestow	noot
	to werreye.	
	atte unset stevene.	
	to rouke.	

3. In what senses does Chaucer use these words:—

every	morwe	sotel	offendid
thankes	or	purveans	queynt

SECTION II.

1. Sketch the story of Palamon and Arcite.

2. From what sources does Chaucer appear to have taken the foundation of the story?

3. Give the character of the Knight from the particulars stated in the prologue.

4. What do we know of the early life of Chaucer? Give a list of his principal works.

POPE.

(Essay on Criticism; Essay on Man; and Rape of the Lock.)

I.

1. To what does Pope allude in the following lines:

Still green with bays each ancient altar stands,
Above the reach of *sacrilegious* hands;
Secure from *flames*, from *envy's* fiercer rage,
Destructive *war* and all-involving age.

2. Explain the allusion in the following passages:—

(a) The fiery soul abhorred in Catiline,
In Decius charms, in Curtius is divine.

(b) Shall burning Ætna, if a sage requires,
Forget to thunder, and recall her fires?

(c) And more true joy Marcellus exiled feels,
Than Cæsar with a senate at his heels.

3. Explain the following:—

Force first made conquest, and that conquest law;
Till superstition taught the tyrant awe,
Then shared the tyranny, then lent it aid,
And gods of conquerors, slaves of subjects made.

4. Explain the allusions in the following passages:—

(a) So Rome's great founder to the heavens withdrew,
To Proculus alone confessed in view.

(b) Fear the just gods, and think of Scylla's fate.

(c) A pipkin there, like Homer's tripod walks.

II.

1. Give a brief analysis of Part II. of the Essay on Criticism.

2. Pope says that in poetry "the sound must seem an echo to the sense." Illustrate this precept from his poems.

3. State clearly the design of the Essay on Man.

4. What, according to Pope, are the functions of self-love and reason?

5. Johnson says:—"The scale of existence from infinity to nothing cannot possibly have being." State Pope's views on this point.

6. Give a brief sketch of the "machinery" of the Rape of the Lock.

(To be continued.)

DISINFECTION OF SEWAGE.

A very important experiment has lately been brought to a successful result at St. Thomas's, Exeter. Last year the Board of Health of that district were indicted for nuisance arising from their sewage outfall, annoying the servants and passengers of an adjoining railway, and were about to expend £1,200 to convey the sewage to a more distant point and discharge it into the River Exe. When just about to incur this heavy expense for so very unsatis-

factory an object, the attention of the Board was called to the successful use of carbolic acid by Mr. McDougal, in disinfecting the sewage of Carlisle, and after long discussions they determined upon adopting the same plan. The result is most satisfactory; £1,200 has not been expended, but instead of it only 10½d. a day is spent for carbolic acid, the sewage is rendered inoffensive, and may be, and probably will be, employed usefully without annoying anyone, and pollution of the river is avoided.

Home Correspondence.

THE EXHIBITION OF 1862 AND RAILWAY COMMUNICATION.

SIR,—In reading the very elaborate article in the *Journal of the Society of Arts* of the 13th inst., by Mr. Robert Bowley, in which such overwhelming masses of railway passengers are recommended to be brought to one focus, and then, by a new line of railway, direct to the Exhibition building, the late disastrous railway accidents are constantly obtruding themselves upon the mind.

The whole system of what is now called, or rather miscalled, railway inspection, appears imperatively to call for an entire revision. I leave, for the present, the important question, whether a military engineer, without any previous knowledge of the construction or of the working of railways, is likely to make a more efficient railway inspector than a civil engineer who, in the practice of his profession, becomes well acquainted with the construction and working of railways. What appears more particularly to call for a speedy remedy is the system of railway inspection. At present the inspector is only "in at the death." He is simply an "accessory after the fact," but appears powerless to prevent an accident. When a fearful calamity takes place, the cause or causes of which can seldom be satisfactorily made out, the railway inspector makes his appearance and questions the witnesses, which, probably, is more than he has a right to do by the limited authority which the legislature has thought proper to confide to railway inspectors. The inspectors of mines are each appointed to a district, and have authority to visit the whole of the works in their district, and to ascertain by personal inspection what precautions are adopted in each locality for the prevention of accidents. The most efficient of these precautions, which are successfully applied in one case, is suggested for adoption at works of a similar nature in the district under inspection. In this way there is really as efficient an inspection as is consistent with the entire responsibility of the owners and managers of the several works, and this is all that ever ought to be attempted.

If this mode of inspection be successful as respects mines, where there exists considerable diversity in the nature of the workings and of the gases evolved, how much more efficient might it not be if applied to railways, where it is possible to introduce a perfectly uniform system when found efficient?

Let a railway inspector have a district of such an extent that, by devoting his entire time to it, he may become thoroughly acquainted with the works and with the mode of working the traffic. He would soon be enabled to ascertain the most efficient and the safest mode of working, and would suggest the introduction of the most efficient modes of operation to the several companies under his inspection, and by the whole of the inspectors acting together and combining their experience, something like a really efficient uniform railway inspection would be the result. Asking a few unimportant questions at an inquest is a complete burlesque upon railway inspection. A periodical and efficient inspection of the whole of the works of a railway, particularly permanent way and tunnels, would very much conduce to the safety of railway travelling. Railway tunnels have all been hastily constructed, and in some cases of inferior materials; and the nature of the work almost precludes the possibility of a very minute inspection during the progress of construction; add to this the sub, or rather the sub-sub-contract system introduced in railway construction, and it will be apparent that works executed under such circumstances should be carefully watched. There can be no doubt but that railway directors would give every facility in their power to a more efficient railway inspection.

I am, &c.,
NEMO.

RAILWAY COLLISIONS.

SIR,—The late dreadful railway slaughters have set all who are exposed to like dangers thinking how they may best be diminished. As I have to spend much of my time on railways, whatever can make them safer is to me a matter of personal as well as of general interest.

Much has been done to diminish the chance of collision, but not all that is needed, as recent examples show. Years ago it was proposed that clocks should be used with two fingers, one to be moved by the clockwork, the other to be set to the time at which the last train passed, by a lever to be moved by the train as it passed. Of course, the distance between the two fingers would show the interval of time elapsed since the fixed finger was set, and the driver of the next train would know pretty nearly how much the preceding train was ahead. The objections to this plan are obviously, first, the cost of procuring as many clocks as would be needed; secondly, the trouble and expense of keeping them all wound up and in order. The advantages might, however, be secured by very simple and cheap means. It would be very easy and inexpensive to erect at short intervals along the line danger signals, to be raised by a lever acted upon by each passing train, and allowed to descend slowly and gradually, the descent being regulated by a fly or other simple regulator. Such a danger signal, if quite up, would inform a driver that the train had just passed, and that he must stop instanter. If partly up, he would know whether 1, 2, 3, or more minutes had elapsed, and would cut off steam more or less accordingly. If the signal was quite down, he would know that no train had passed, at the least, during the time necessary for the signal to descend, and he might proceed with confidence.

If such signals were used at sufficiently short intervals, there would be little risk of one train overtaking another unawares.

If railway companies would compel their managers, station masters, and all other servants concerned in any accident, to pay a part of the loss occasioned by them, accidents would be less frequent. Of course, if those employed had to bear this extra risk, they would require larger remuneration, which would be a cause of profit to the careful but of loss to the careless. The extra remuneration would be money well laid out. It is stated in to-day's *Times*, that last year the railway companies paid in compensation for accidents and losses £181,170. Much of that large sum might have been saved were part of the risk thrown upon the managers, &c., and they paid to incur that risk, getting profit in proportion to their success in avoiding it. The real loss from accidents is far greater than the compensation paid, for carriages and engines are broken, and to some extent travelling discouraged. To increase risk by saving, is extravagant economy.

I am, &c.,
P. H. HOLLAND.

36, Cavendish-square.

Proceedings of Institutions.

THE FAVERSHAM INSTITUTE.—The seventh annual meeting was held on Tuesday, Sept. 10th. The report represented that the Institute had enjoyed a year of great prosperity. The number of members had been raised to 682, giving an increase during the year of 195. The

income had been £190 14s. 6d., and the expenditure £187 9s. 6½d. The library had received no less than £53 1s. 5d., with which had been purchased upwards of 200 volumes. Lectures had been delivered by Messrs. Blake, Vincent, Wheeler, Massey, Parsons, Drs. Letheby, and Lankester, Mrs. Balfour, and Rev. Paxton Hood. The entire cost of the course had been more than covered by the sale of lecture tickets and payments at the door. The *soirée* had been well attended, and a profit had been realised thereby. Prizes had been offered to induce members to compete in the writing of an essay and in the construction of a map of England and Wales. The successful competitors received their rewards at the last annual *soirée*, at the hands of the Mayor of Faversham. A singing class had been established and had become a very important auxiliary. A great effort had been made to obtain a suitable building for the purposes of the Institute, and the funds raised for that object had enabled the committee to purchase a most eligible site, and to obtain very excellent plans, a considerable portion of which would, in all probability, be carried out by the end of May, 1862. An attractive course of lectures would be delivered during the approaching winter season. The members of this Institute have access to a library and can attend a course of lectures on payment of three shillings per annum.

GLASGOW MECHANICS' INSTITUTION.—The new building erected by the directors of the Mechanics' Institution having recently been finished, it was formally opened on the 30th of August by a conversazione, at which there were between 400 and 500 persons present. In the new building there are four floors above the level of the street, and under these a basement floor, containing the house of the janitor and other suitable accommodation. In these four floors there are a library and lecture hall capable of accommodating four hundred students—ten well-lighted class rooms of great capacity and convenient access. The front is divided into five bays, in the centre of which, on the ground floor, is the doorway, covered by a Doric portico projecting several feet from the front wall. The entablature of the portico is carried along the whole front, dividing the façade into two orders. A colonnade of six attached Ionic columns forms the upper order, and embraces two floors in its height. The entablature of this order, with an imperforated parapet, alone complete the elevation. Bailie Couper, President of the Institution, took the chair, in the large lecture hall, and on and around the platform were—Mr. Sheriff Barclay, Perth, Bailie Govan, Deacon-Convener M'Lellan, Councillors Binnie, Martin, James Taylor, M'Culloch; Rev. Dr. Jamieson; Messrs. Wm. M'Adam, A. K. Murray, David Moore, James Inglis, Wm. Haddow, Robert M'Intyre, John M'Dougall, Wm. M'Lellan, Mossman, &c., &c. The meeting having been opened with prayer by the Rev. Dr. Jamieson, Bailie Couper said—Ladies and gentlemen, it is very gratifying for me to see so many friends assembled upon this particular occasion to inaugurate this beautiful and interesting edifice. This is a period in the history of the Institution that calls for renewed zeal and energy from all its friends. I have now had the honour of being its president for four years, and can bear testimony to its progress and proficiency, and the high position it now occupies; thanks to the untiring care and watchfulness of the directors, the energy and ability of the lecturers and teachers. The students also that have attended the classes hitherto deserve the highest commendation. The accommodation in the lecture halls and large class rooms is larger and much better than was had in the old buildings in Hanover-street. The new arrangements already made, and the others that are now in progress, will, when completed, largely benefit the industrial classes to a degree never before attained. We expect and earnestly desire the support and assistance of the people generally; nay more, we look forward to a coming day when the working classes of Glasgow will freely and cheerfully cast in their mite for the sustenance of their own Institution, which has been erected, and is managed solely and excusively for their own particular benefit. Thousands of young men have been educated in the Glasgow Mechanics' Institution, and not a few of them can date their success and prosperity in the world to the valuable instruction they there received. But while some would gladly admit this fact, still they cannot understand why it is that an institution of such a benevolent kind should have an edifice of such a costly description. We reply, that when we looked at the great city of Glasgow itself, which fills so much space in the eyes of the world, and when we thought of her public spirit and public Institutions, and we considered the all-important fact that Glasgow was the first city wherein was established a Mechanics' Institute, we the directors, felt warranted to add a public building that would not only be useful, but also of such an architectural character as would be thoroughly in keeping with the times in which we live, and which also would command the entire approbation of our fellow-townsmen. Every effort will be made to extend the library and the museum. The drawing department will be furnished with every requisite to give additional advantage to the students. No pains will be spared in giving every facility of conveying useful and solid instruction, for the purpose of improving and fixing upon the minds of young men principles that will ultimately tend to their own personal good, and to the good and well-being of society wherever Providence may direct. I am delighted to observe that there are present amongst us many gentlemen who took an active part in establishing the Glasgow Mechanics' Institution, now nearly forty years ago; and it gives me an additional pleasure to name Sheriff Barclay as one of the most earnest and active members of that period.—Sheriff Barclay then gave some of the early history of the Institution, and Bailie Govan, Mr. Cunliffe, and Mr. More afterwards briefly addressed the meeting, and the proceedings were brought to a close by a vote of thanks to Sheriff Barclay.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, September 13th*, 1861.]

Dated 25th June, 1861.

1623. F. Warren, Birmingham—Imp. in the machine used for cleaning cotton, and commonly called "Churka or roller gin."

Dated 29th June, 1861.

1665. W. Clark, 53, Chancery-lane—Imp. in excavating machinery. (A com.)

Dated 6th July, 1861.

1722. W. Pask, Sydney, Gloucestershire—Procuring a colouring matter from the refuse of iron stone, called "Colour spert."

Dated 15th July, 1861.

1776. T. Cobley, Meerholz, Germany—An improved process for the production or manufacture of fluo-silicates of tin, zinc, and baryta, and their application as pigments for glazing, enamelling, and in the manufacture of glass.

Dated 16th July, 1861.

1790. J. P. Gillard, Paris—Imp. in the manufacture of soda, carbonate of soda, and hydrochloric acid, and in apparatus connected therewith.

Dated 22nd July, 1861.

1836. C. N. Kottula, Holborn—Certain new compositions to be used in the manufacture of soap.

1840. W. E. Newton, 66, Chancery-lane—Imp. in engines for obtaining motive power by an explosive mixture of inflammable gases and air. (A com.)

Dated 23rd July, 1861.

1846. R. Thompson, Charlton, Kent—Imp. in machinery for cutting wood.

Dated 27th July, 1861.

1885. J. Robertson, 53, Park-street, Mile End—Imp. in apparatus for the treatment of bodily pain with hot water, steam, hot air, and the like.

Dated 1st August, 1861.

1910. H. Mearing, 18, Great Randolph-street, Camden-town—An improved lucifer match and prepared paper for igniting the same.

Dated 7th August, 1861.

1967. L. W. Viollier, Lyons—Imp. in machinery for doubling and twisting yarns and threads, and for manufacturing wire rope. (A com.)

Dated 8th August, 1861.

1974. R. De Clercq and E. Chazelles, Brussels—Imp. in machinery or apparatus for raising water and other fluids.

Dated 12th August, 1861.

2004. A. Salomons, Old Change—A bodice skirt, a new or improved article of female apparel. (A com.)

Dated 14th August, 1861.

2026. W. Wilds, Hertford—Imp. in apparatus for ventilating.

Dated 15th August, 1861.

2032. J. C. Martin, Barnes, Surrey—An imp. in treating bones, and in the manufacture of the products thereof.

Dated 17th August, 1861.

2050. Z. Colburn, 15, Tavistock-street, Bedford-square—Imp. in apparatus for heating water intended for the supply of steam boilers.

Dated 19th August, 1861.

2053. W. Bennett, 14A, London-street, Paddington—A new and improved composition to be used as fuel and in the lighting of fires.

Dated 20th August, 1861.

2074. R. S. Lambert, White-hall, Clevedon, Somersetshire—An improved "skipping dipper" or vessel for removing sugar and other liquids from boiling pans.

2078. N. Fisher, Milton, near Blisworth, Northamptonshire—Imp. in agricultural implements for grubbing and cultivating land.

Dated 23rd August, 1861.

2104. J. Whitworth and W. W. Hulse, Manchester—Imp. in sights for small arms and ordnance, and in fitting apparatus used with small arms.

2106. J. Dunn, Alnwick, Northumberland—An imp. or imps. in reaping machines.

2108. S. Elson, Oldham—Imp. in apparatus for heating the feed water of steam boilers, superheating steam and furnace condensation.

2110. R. A. Brooman, 166, Fleet-street—An improved method of treating the hop plant to obtain a material resembling wool. (A com.)

2112. W. Evans, Willow-walk, and E. Concanen, Cheshunt-terrace, Grange-road, Bermondsey—A new manufacture of pens or writing instruments.

Dated 24th August, 1861.

2114. M. Hyams, 55, Bath-street, City-road—Imp. in the manufacture of smoking pipes and cigar tubes, and preparing, washing, coating, covering, or otherwise impregnating them with aromatic substances in a solid, liquid, or aeriform state.

2116. W. Clissold, Dudbridge Works, near Stroud—Improved apparatus for oiling wool.

2118. H. B. Coathupe, Junior United Service Club, St. James's—Imp. in timekeepers.

Dated 26th August, 1861.

2128. J. C. Haddan, Bessborough-gardens, Pimlico, and C. Minasi, St. James's-terrace, Camden-town—Imp. in the manufacture of projectiles and of cartridges.

2130. H. Attwood, Wapping-wall, Middlesex—Imp. in cleansing and in feeding boilers.

Dated 27th August, 1861.

2134. J. Smith and W. Smith, Keighley, Yorkshire—Imp. in spindles and flyers used in machinery for spinning and twisting fibrous substances.

2136. J. B. Fondu, Lodelinsart, Belgium—Imp. in the construction of fire grates for steam and other boilers, and suitable to all kinds of fires.

2138. R. A. Brooman, 166, Fleet-street—Imp. in the construction of temples or stretching rollers for looms. (A com.)

Dated 28th August, 1861.

2140. A. Granger, Holborn—Imp. in the manufacture of shirt collars and fronts, wristbands or cuffs, neck ties, or other similar articles of wearing apparel.

2142. B. Browne, 52, King William-street—An improved process and apparatus for concentrating ores or tailings or separating pulverized mineral substances of different kinds or qualities from each other. (A com.)

2144. T. Bray, Dewsbury, Yorkshire—Imp. in ornamenting wood in imitation of inlaid work.

Dated 29th August, 1861.

2148. S. Corbett, Park-street Works, Wellington, Salop—Imp. in mills for crushing and grinding mineral and vegetable substances, and for hulling or shelling beans and oats and other grain and seeds.

2149. J. Harding, Manchester—An improved Inverness cape.

2150. J. Love, Lower Brook-street, Grosvenor-square—An improved signal. (A com.)

2151. V. A. Janvier, Wilton-square, New North-road—Imp. in fastenings for gloves, belts, and other articles.

2152. P. Jewell, Bond-street, Brighton—Imp. in concertinas.

2153. A. V. Newton, 66, Chancery-lane—Improved machinery for cleaning rice and other grain. (A com.)

Dated 30th August, 1861.

2159. A. Taille, Agen, France—An improved manufacture of manure.

2161. H. W. Spencer, Stepney-causeway, Commercial-road—Imp. in the manufacture of animal oils, the said imps. relating more particularly to the processes of refining them to be used for lubricating purposes.

2163. J. Harris, Hanwell, Middlesex—Imp. in stopping or retarding railway and other carriages and trains, locomotive and stationary engines and machinery, together with apparatus employed therein, which apparatus is applicable to the raising and lowering of weights and other purposes for which power is required.

2165. C. Worms and J. Warburton, Bradford—Imp. in treating animal fibre recovered from rags, composed of mixed animal and vegetable fibre.

2167. H. Brand, Guildford-place, Clerkenwell—Imp. in mattresses formed with springs.

Dated 31st August, 1861.

2171. P. Taylor, City-road, Hulme, Manchester—Imp. in apparatus for removing the sediment from, and preventing incrustation in, steam boilers.

2173. W. Southwood, 7, Barkham-terrace, Saint George's-road—An improved method of making boots and shoes, or of parts thereof.

2175. J. Copple and E. Copple, Eccleston, near Prescot, Lancashire—Imp. in apparatus to prevent over winding at coal and other mines.

2177. J. Jones, 55, North John-street, Liverpool—Imp. in clasps or fastenings for garments, belts, harness, and like articles.

2179. J. M. Dunlop, Manchester—Imp. in cleansing cotton seeds, and in machinery used for such process.

Dated 2nd September, 1861.

2187. J. Hall, Oldham—Imp. in portable pumps or engines for extinguishing fires and other purposes.

2189. E. Alcan, Coleman-street-buildings—Imp. in machinery for carding and combing wool and other filamentous substances. (A com.)

2191. G. Knight, Foster-lane—Imp. in giving lustre to written and printed letters, figures, and devices.

Dated 3rd September, 1861.

2193. D. Ward, Beaminster, Dorsetshire—Improved machinery for twisting and laying flax, hemp, and other fibrous materials.

2195. E. Suckow and E. Habel, Oldham—Imp. in machinery or apparatus for producing a strong blast or current of air.

Dated 4th September, 1861.

2199. T. Scott, Newcastle, Down, Ireland—Imp. in the construction of roadways.

2201. W. E. Newton, 66, Chancery-lane—Imp. in self-acting brakes applicable to railway or locomotive engines and carriages. (A com.)

PATENTS SEALED.

[*From Gazette, September 13th*, 1861.]

September 12th.

622. J. L. Jullion.
635. G. Simmons.
637. E. T. Truman.
638. E. A. Pontifex.
641. B. Samuelson.
646. J. Marson.
650. W. Lorberg.
651. C. J. Burnett.
653. E. Green and J. Green.
654. A. Smith.
657. J. Watkins.
663. J. I. Taylor.
664. J. Holden.
665. A. Drevelle.
667. F. Jenkin.
668. E. C. Morgan.
669. A. Prince.
670. W. F. Henson.
671. E. E. Scott.
678. C. N. Kottula.
682. J. S. Miller & T. P. Miller.
687. B. West.
690. G. W. Hawksley and M. Wild.
694. J. Watson and T. B. Davidson.
705. M. J. F. Chappellier.
710. W. Andrews.
727. S. Jackson.
746. S. A. Beers.
754. G. F. Morrell.
756. S. Lamb.
764. W. Grimshaw.
856. W. E. Gedge.
871. W. Westbury & E. Cooke.
906. J. C. Rivett.
987. G. A. Huddart and J. D. E. Huddart.
1028. T. Greenwood.
1339. G. Asher.
1582. J. Cullen.
1716. J. R. Black and H. W. Spratt.
1738. F. S. Barff.
1769. E. Briggs and S. Fearnley.
1847. J. H. Johnson.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, September 13th*, 1861.]

September 9th.

2086. R. Lakin and J. Wain.

September 10th.

2050. J. L. Chester.
2058. D. Cheetham.
2064. J. M. Courtauld.

September 11th.

2069. L. Kaberry and T. Mitchell.

[*From Gazette, September 17th*, 1861.]

September 12th.

2109. A. Turner.
2123. J. Dewrance.
2151. G. L. Turney.
2284. J. Braby and J. Braby, jun.

September 13th.

2087. A. H. J. Bastable.
2090. F. Fowke.

September 14th.

2107. J. G. N. Alleyne.
2121. J. Bethell.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[*From Gazette, September 13th*, 1861.]

September 9th.

2047. E. Sharpe.